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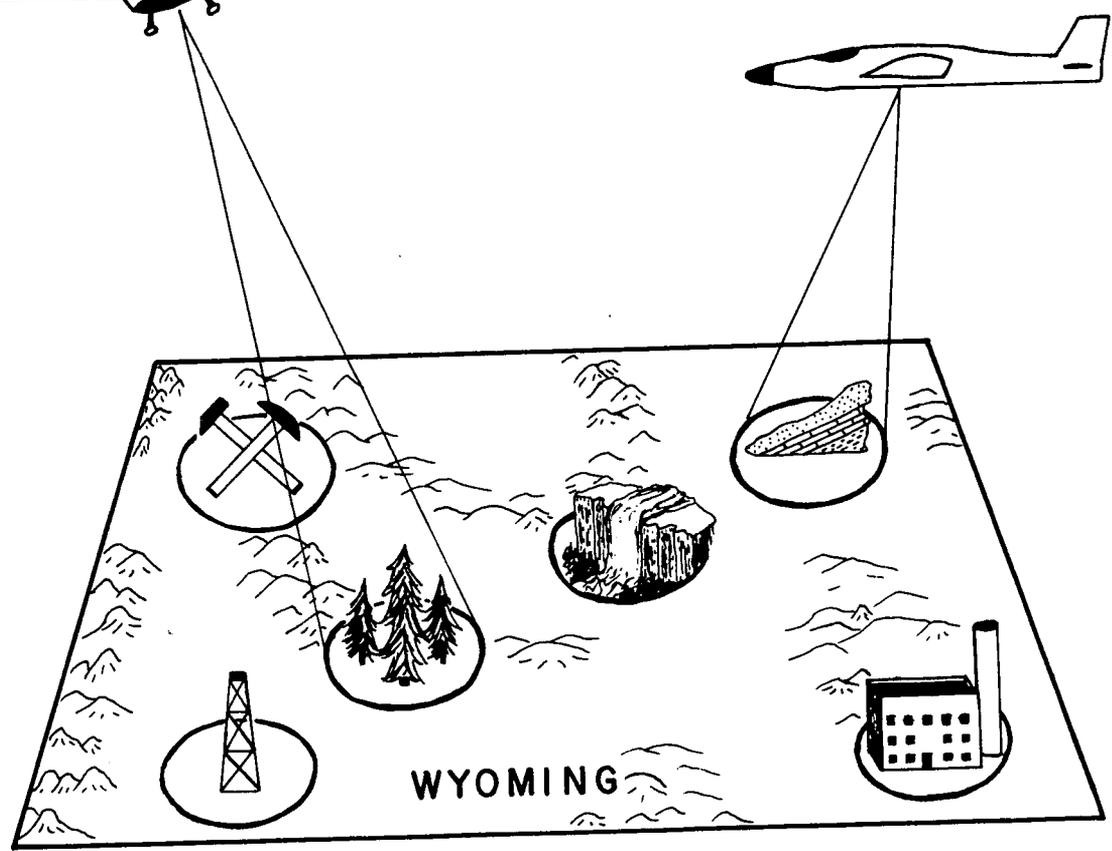
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ANALYSIS OF ERTS-1 IMAGERY OF WYOMING AND ITS APPLICATION
TO EVALUATION OF WYOMING'S NATURAL RESOURCES

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16. Abstract The Wyoming investigation has progressed according to schedule during the Jan.-Feb., 1973 report period. A map of the maximum extent of Pleistocene glaciation was compiled for northwest Wyoming from interpretations of glacial features seen on ERTS-1 imagery. Using isodensitometry as a tool for image enhancement, techniques were developed which allowed accurate delineation of small urban areas and provided distinction of broad classifications within these small urban centers. Results of these studies were presented at the ERTS-1 Symposium, March 5-9, 1973.			
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R. W. Marrs

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OBJECTIVES OF THE CONTRACT

The principal objectives of the Wyoming program is to apply the ERTS satellite imagery and supporting aircraft and ground-control data to the study of geological, botanical, and agricultural features in the State of Wyoming. The resulting information aids in the achievement of practical goals in inventory and management of natural resources.

WORK SUMMARY

During the January 1 to March 1, 1973 period the Wyoming ERTS-1 investigation has continued in much the same manner as before, with work in most phases of the program progressing smoothly.

Dr. R. S. Houston's special report on his study of the Granite Mountains area of central Wyoming (Houston, Feb. 1973) summarizes the results of his efforts to distinguish lithologies and compile a geologic map for the Precambrian terrain of the Granite Mountains area using ERTS-1 and aircraft imagery. Among the more significant results of this study was the discovery of several outcrops of iron formation which were not identifiable from the ERTS-1 imagery, but were readily identified from the supporting intermediate- and high-altitude aircraft imagery. As a follow-up to this discovery, a cooperative effort is underway in which investigators at the University of Wyoming and R. K. Vincent of the Environmental Research Institute of Michigan (ERIM) are attempting to apply atmospheric correction and image ratioing techniques to the Wyoming imagery in order to enhance areas of iron-rich outcrop.

The Wyoming investigators are continuing their efforts to define structural trends and lithologic boundaries in various areas. Early results of this work were presented in previous special reports (Blackstone, 1972; Parker, 1972).

Summary reports on the applications of ERTS-1 imagery to land-use mapping in Wyoming (Breckenridge, Marrs, and Murphy, 1973) and glacial geomorphology (Breckenridge, 1973) were presented at the Goddard ERTS-1 Symposium (March 5-9, 1973). The more significant aspects of each of these studies are summarized in the "Significant Results" section of this report.

We have recently experienced a setback in the application of ERTS-1 imagery to vegetation mapping. The bulk of this work was being conducted by Mr. Francis Redfern, a graduate research assistant in Botany. Mr. Redfern has elected to leave the University of Wyoming and will no longer be participating in the ERTS-1 investigation. He is presently preparing a report on his progress of the past months.

This setback in the vegetative studies has been minimized by the recent addition to the program of a graduate assistant from the Plant Science Department, Mr. Robert Gordon. Mr. Gordon has begun a study in which he will apply the interpretation of ERTS-1 imagery to rangeland mapping. He has chosen as a test area a region near Baggs, Wyoming for which information from aircraft overflights and ground observations is also available.

Dr. Edward Decker, of the University of Wyoming Geology Department, has begun developing a capability to perform several basic computer enhancement procedure. Consequently, we have requested bulk computer-compatible tapes for the two Wyoming images (1013-17294 and 1030-17242). If Dr. Decker is successful, we anticipate that the additional capability will be of value for specific problems where identification by clustering or contrast enhancement is desirable.

SIGNIFICANT RESULTS

Significant results to be reported for the January-February, 1973 report period include results of the glacial geomorphologic studies conducted by Mr. Roy Breckenridge and the land-use evaluation conducted by Messrs. Breckenridge, Marrs, and Murphy.

Interpretation of black and white and color-composite ERTS-1 Imagery allowed Mr. Breckenridge to compile, for the first, time, a regional map of the maximum extent of Pleistocene glaciation in northwestern Wyoming. Some areas had not been studied previously because of their inaccessibility, others had been studied in varying detail, but never before was the synoptic view available which is necessary for regional mapping.

The ERTS-1 imagery provides an excellent base for mapping both erosional and depositional glacial features. Various geomorphologic features related to paleo-glacial flow patterns were seen on the ERTS-1 imagery and were used in determinations of directions of ice movement and glacial transport of materials. Active snow fields and glaciers are readily discernable on the ERTS-1 imagery, and with repetitive coverage, significant changes in their size or distribution could certainly be detected. Also of considerable significance are the glacial deposits mapped from the ERTS-1 imagery. Some of these serve as aquifers and are important in the hydrologic pattern in northwest Wyoming.

Results of the ERTS-1 imagery to land-use studies indicate ERTS-1 imagery will be extremely useful in land planning in Wyoming. Some success was achieved in each of the attempted land-use studies. Some were very successful, others were only marginally successful.

In the Powder River Basin studies, water impoundments as small as one acre were detected and water bodies larger than five acres could be mapped and their acreage estimated. Flood plains and irrigated lands were successfully mapped,

and some individual crops were identified and mapped. Coniferous and deciduous trees were segregated using color-additive viewing as an enhancement technique. Gross soil distinctions were made by interpretation of the ERTS-1 imagery and were found to be closely related to the bedrock geology and compared favorably with broad scale soils maps. Several broad, potentially unstable areas were identified. These were related to specific geologic and slope conditions. Some closed geologic structures were mapped, recently developed oil fields were located, and large open-cut mines were mapped from the imagery.

The most difficult task accomplished was that of mapping urban areas. The relatively small size of Wyoming towns and the greatly varied surroundings initially thwarted attempts at urban mapping. Densitometry proved to be useful in making the necessary, subtle distinctions. Four-color isodensitracings for each of the four ERTS-1 MSS bands were interpreted individually and as composites. These interpretations permitted accurate mapping of many of the populated areas that were formerly indistinguishable. Sometimes these interpretations even provided distinction between new and old residential areas, industrial, commercial, and business districts, and open or undeveloped areas within the towns. Larger, individual features, such as airstrips, factories, schools, golf courses, parks, and cemeteries, could often be mapped but most could not be identified.

Snow-cover provides a considerable degree of enhancement of urban areas by providing increased contrast between the populated areas and their surroundings. Comparison of isodensitracings of snow-covered and non-snow-covered images provides a striking example of the additional detail available for snow-enhanced images.

CONFORMANCE WITH WORK SCHEDULE

We are presently on schedule with Phase III (Continuing data analysis) of

the Wyoming ERTS-1 program. Investigators are now preparing for the summer field season during which various aspects of the ERTS-1 image interpretations must be field-checked to establish their validity. We have yet to achieve substantial results in the use of ERTS-1 imagery for hydrologic studies and vegetation mapping, but we feel that the necessary repetitive coverage is now (or soon will be) available so that these aspects of the investigation can be completed. We anticipate that all phases of the Wyoming ERTS-1 investigation will be completed as scheduled.

DISCUSSION OF PROBLEMS

The only continuing problem from the beginning of the Wyoming investigation has been the lack of appropriate data products in certain areas of interest. This situation has been somewhat relieved with the continuing acquisition of imagery from successive satellite passes. Also, there has been notable improvement in the quality of some data products (particularly the 70mm negatives). Recent data shipments have more nearly conformed to the standing order and all products received have been of acceptable quality. In addition, we were extremely pleased when we received color composites for five of the Wyoming ERTS-1 images after having been informed that such products would probably not be supplied.

The single remaining problem with regard to available data is that of the retrospectively ordered images. Specifically, we have requested needed images from partial shipments that were never completed and a set of images from a series of passes not originally included in our standing order (Sept. 7-12, 1972). The microfilm catalogue shows that the particular set of images was (and still is) the only cloud-free and snow-free coverage over the two areas of critical interest in the Wyoming investigation. The desired imagery was requested in December and has not yet been received.

We have experienced a slow-down in the photointerpretive portions of our

work during the January-February, 1973 report period because two of our laboratory instruments were returned to the manufacturer for repairs. We have received notice that the repairs have been completed and these instruments should be back in service shortly.

ADEQUACY OF FUNDS

Our financial status has not changed significantly since the July-December, 1972 summary report. Expenditures have been within budget limits, but expenses for photographic processing and materials continue to be slightly higher than originally anticipated. As yet, this has not seriously effected the overall budget.

PERSONNEL

No changes in personnel were made during the January-February, 1973 report period, but, as mentioned earlier, Mr. Francis Redfern will not participate in the Wyoming ERTS-1 program after the current academic semester ends. Other project investigators will continue the proposed evaluations of ERTS-1 for vegetative mapping, so the contract objectives should not be affected.

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